MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

PPH 0135 – ELECTRICITY AND MAGNETISM

(All sections / Groups)

11 MARCH 2016
3.00 p.m - 5.00 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 7 pages excluding the cover page and the appendices with **FOUR** questions only.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary workings must be shown.

Answer **ALL** questions.

Question 1: [15 marks]

a) Consider the electric field lines shown in **Figure Q1 (a)**. State the type of charge (positive or negative) for A and B. Explain your answer.

(3 marks)

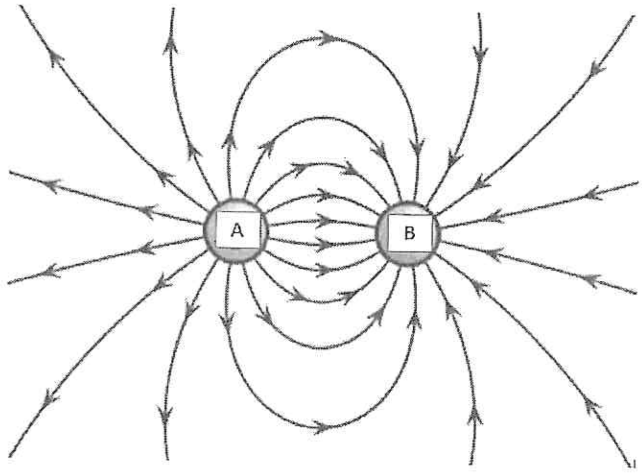

Figure Q1 (a)

b) Copy **Figure Q1 (b)** onto your answer script and sketch the direction of magnetic field of the magnetic bar.

(2 marks)

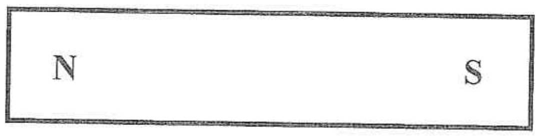

Figure Q1 (b)

Continued...

c) An electron travels at an angle of 40° with the direction of a magnetic field of 0.4 T in the y-axis and lying in the x-y plane as illustrated in **Figure Q1 (c)**. The velocity of the electron is 3.00×10^6 m/s.

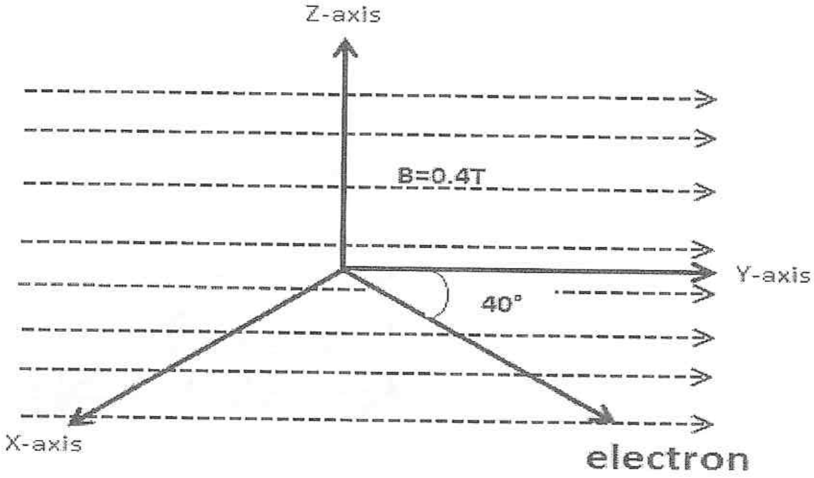

Figure Q1 (c)

i) Calculate the magnitude of the magnetic force on the electron.

(3 marks)

ii) Given that the mass of electron is 9.11×10^{-31} kg, calculate the acceleration experienced by the proton.

(2 marks)

d) **Figure Q1 (d)** below shows three current carrying straight conducting wires placed parallel to each other. Determine the magnitude and direction of net magnetic force acting on wire B of 30 cm long.

(5 marks)

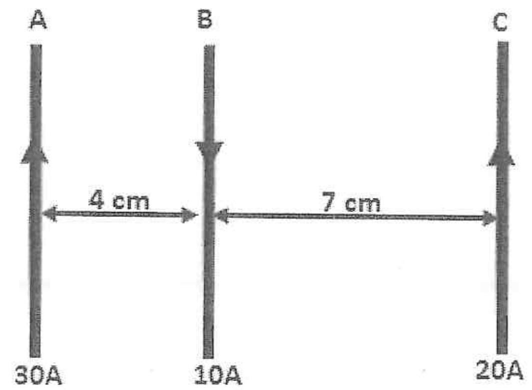

Figure Q1 (d)

Continued...

Question 2: [15 marks]

a) **Figure Q2 (a)** below shows a combination of resistors in a circuit diagram.

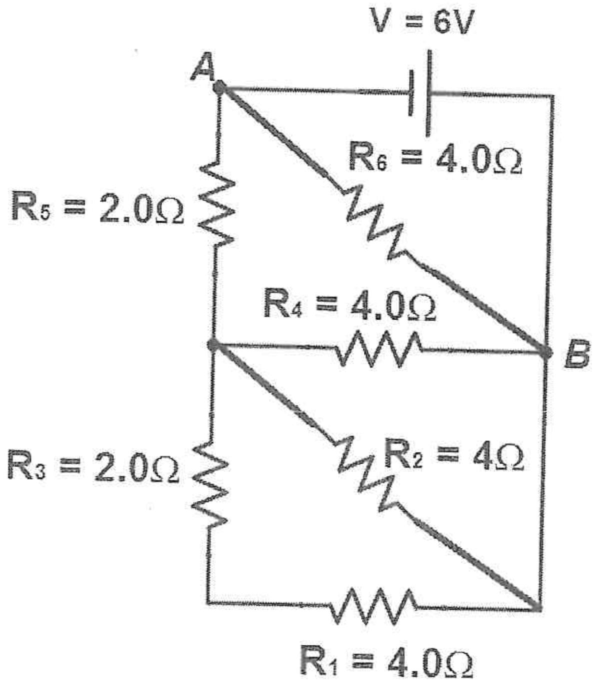

Figure Q2 (a)

i) Calculate the total resistance of the circuit (equivalent resistance between terminals *A* and *B*).

(2.5 marks)

ii) Determine the total current withdrawn from the battery.

(1 mark)

iii) Calculate the current flowing through R_1.

(3.5 marks)

b) A circuit diagram combining three resistors is shown in **Figure Q2 (b)** below.

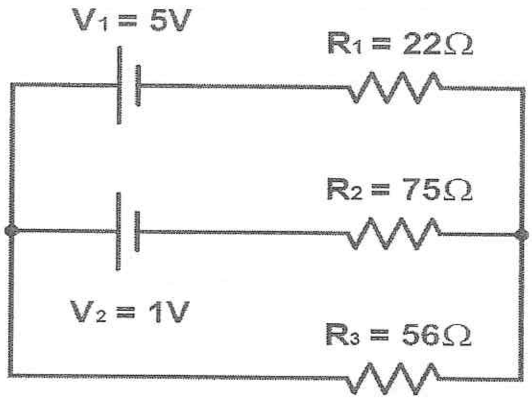

Figure Q2 (b)

i) Use Kirchhoff's Laws to calculate the magnitude and direction of current flowing in R_3.

(4.5 marks)

ii) By taking R_3 as the load resistor (R_L), provide a Thevenin's equivalent circuit and determine the load current.

(3.5 marks)

Continued...

Question 3: [10 marks]

a) A capacitor of 3.6 μF is connected to an alternating voltage source with an rms value of 10.0 V. A current of 30 mA flows through the capacitor as shown in **Figure Q3 (a)**. Calculate the frequency of the voltage source.

(2 marks)

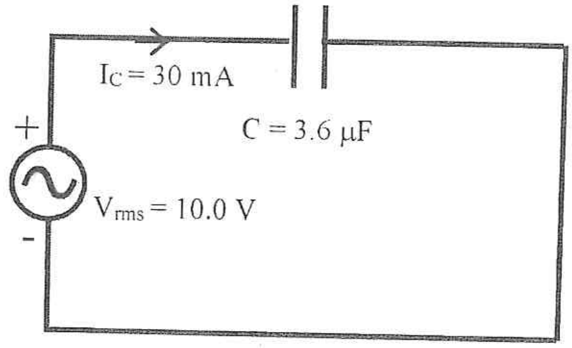

Figure Q3 (a)

b) The capacitor in (a) is then replaced by an ideal coil with an inductance of 0.180 H as illustrated in **Figure Q3 (b)**. Calculate the rms current through the coil, $\mathbf{I_L}$.

(2 marks)

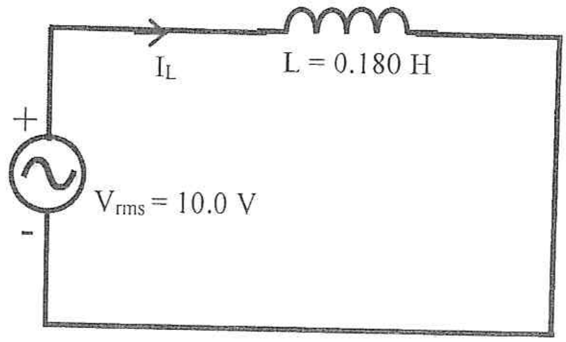

Figure Q3 (b)

c) Consider the circuit shown in the **Figure Q3 (c)**,

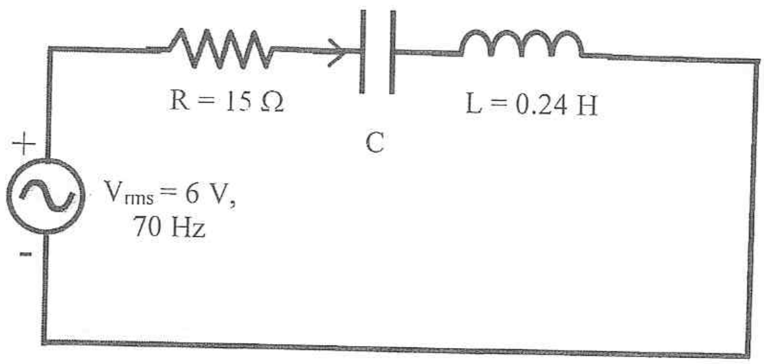

Figure Q3 (c)

i) if $C = 60\ \mu F$, calculate the reactance of the capacitor.

(1 mark)

ii) Calculate the rms current in the circuit.

(3 marks)

iii) Draw the appropriate phasor diagram for this system and calculate phase angle, ϕ.

(2 marks)

Continued...

Question 4: [10 marks]

a) Explain the terms "Doping" and "Depletion region".

(2 marks)

b) Explain how the electric field across *pn* junction is created.

(2 marks)

c) Calculate α_{dc}, I_B, I_E, I_C, R_C, and V_{CB} in **Figure Q4(a)** below, given that $\beta_{dc} = 50$ and $V_{CE} = 15.3\text{V}$. Assume that the transistor is of germanium type.

(6 marks)

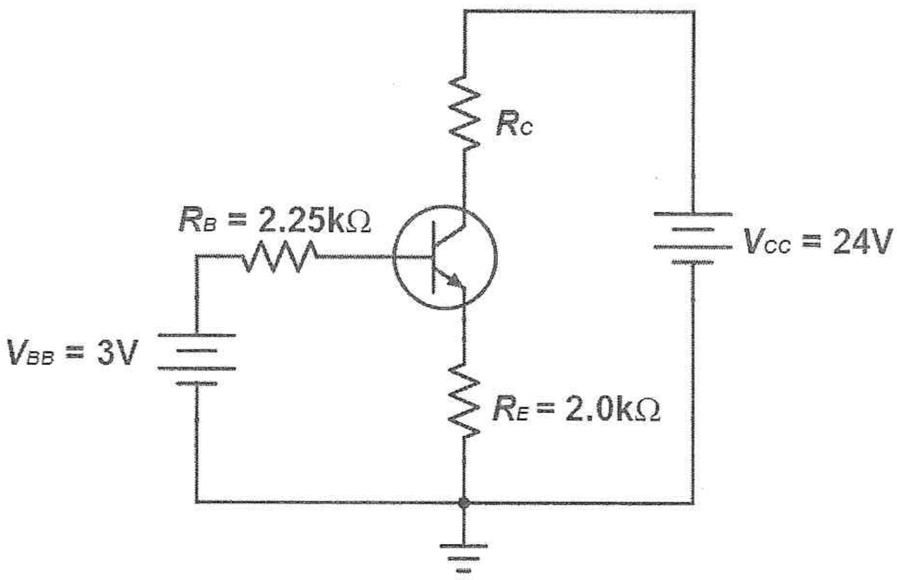

Figure Q4(a)

End of Paper

APPENDIX 1

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	9.11×10^{-31} kg
Proton mass,	m_p	1.67×10^{-27} kg
Elementary charge	e	1.602×10^{-19} C
Gravitational constant	G	6.67×10^{-11} N.m^2/kg^2
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	1.38×10^{-23} J/K
Compton wavelength	λ_c	2.426×10^{-12} m
Planck's constant	h	6.626×10^{-34} J.s
Speed of light in vacuum	c	3.0×10^{8} m/s
Rydberg constant	R_H	1.097×10^{7} m^{-1}
Acceleration due to gravity,	g	9.81 m /s^2
Atomic mass unit (1u)	u	1.66×10^{-27} kg
Avogadro's number	N_A	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing	I_o	1.0×10^{-12} W /m^2
Coulomb constant	k	8.988×10^{9} N m^2 /C^2
Permittivity of free space	ε_o/κ_o	8.85×10^{-12} C^2/N.m^2
Permeability of free space	μ_o	$4\pi \times 10^{-7}$ H/m

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc}+1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1-\alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 n I$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N\frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L\frac{dI}{dt}$$

$$\xi = -M\frac{dI}{dt}$$

$$F = BIL\sin\theta$$

$$F = qvB\sin\theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{tot} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{max}\sin\omega t$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x}\right) I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_0 N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_o N_1 N_2 A}{l}$$

$$P = IV = I^2 R = \frac{V^2}{R}$$

$$P_t = I_{rms} V_{rms}\cos\phi$$

$$P_r = V_{rms} I_{rms}\sin\phi$$

$$P_a = I_{rms}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0[1 + \alpha(T - T_0)]$$

$$R_T = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIA\sin\theta$$

$$U = \frac{1}{2}LI^2$$

$$U = \frac{1}{2}B^2 A\frac{l}{\mu_o}$$

$$V_H = Bvd$$

$$V = V_{max}\sin\omega t$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T}\right) V_S$$

$$X_C = \frac{1}{2\pi f C}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\oint B.dl = \mu_o I$$

$$d\mathbf{B} = \frac{\mu_O I}{4\pi}\frac{d\ell \times \hat{\mathbf{r}}}{r^2}$$

$$\Phi_B = BA\cos\theta$$

$$\cos\phi = \frac{R}{Z}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$